

(43) Date of A Publication 07.08.1996

BEST AVAILABLE COPY

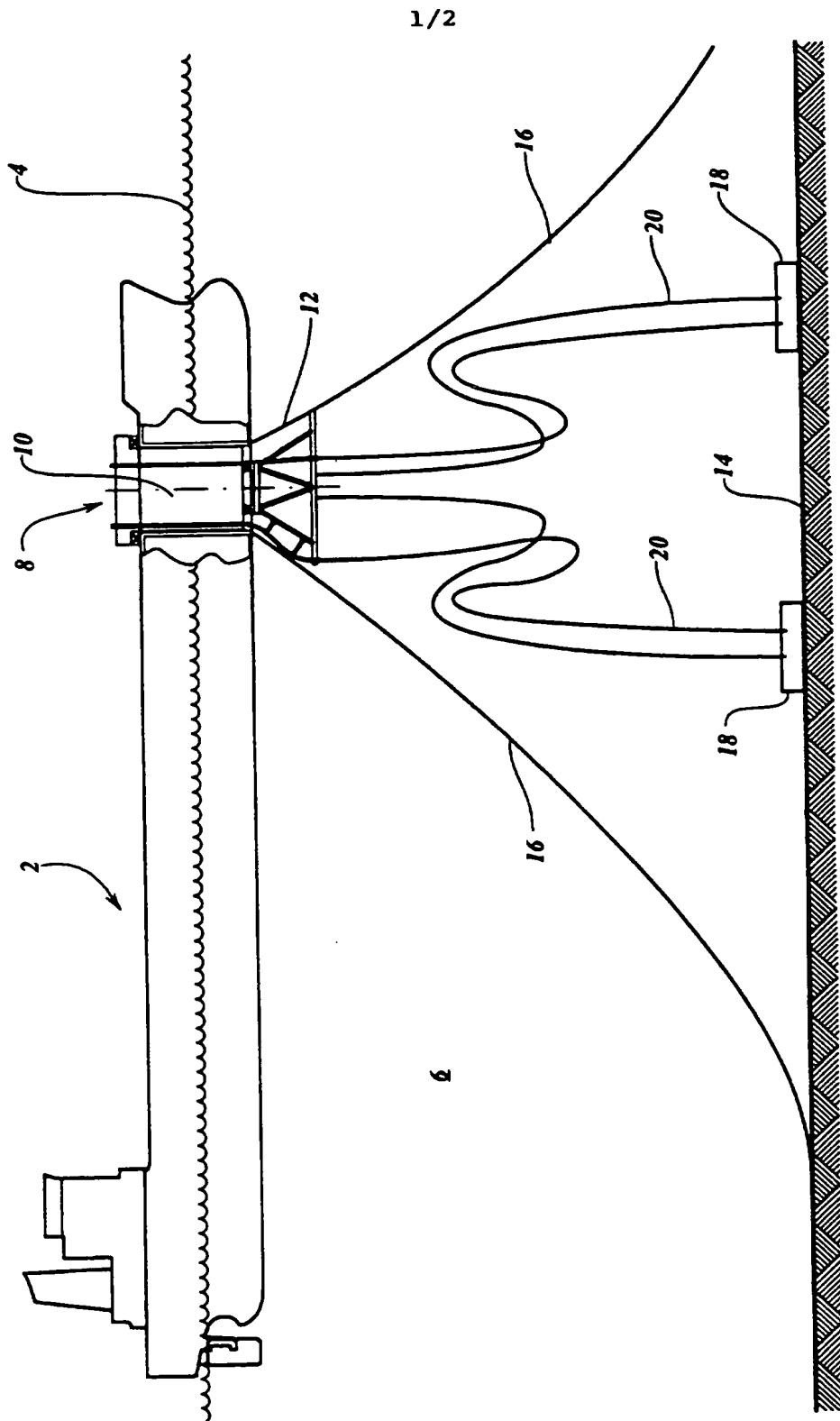
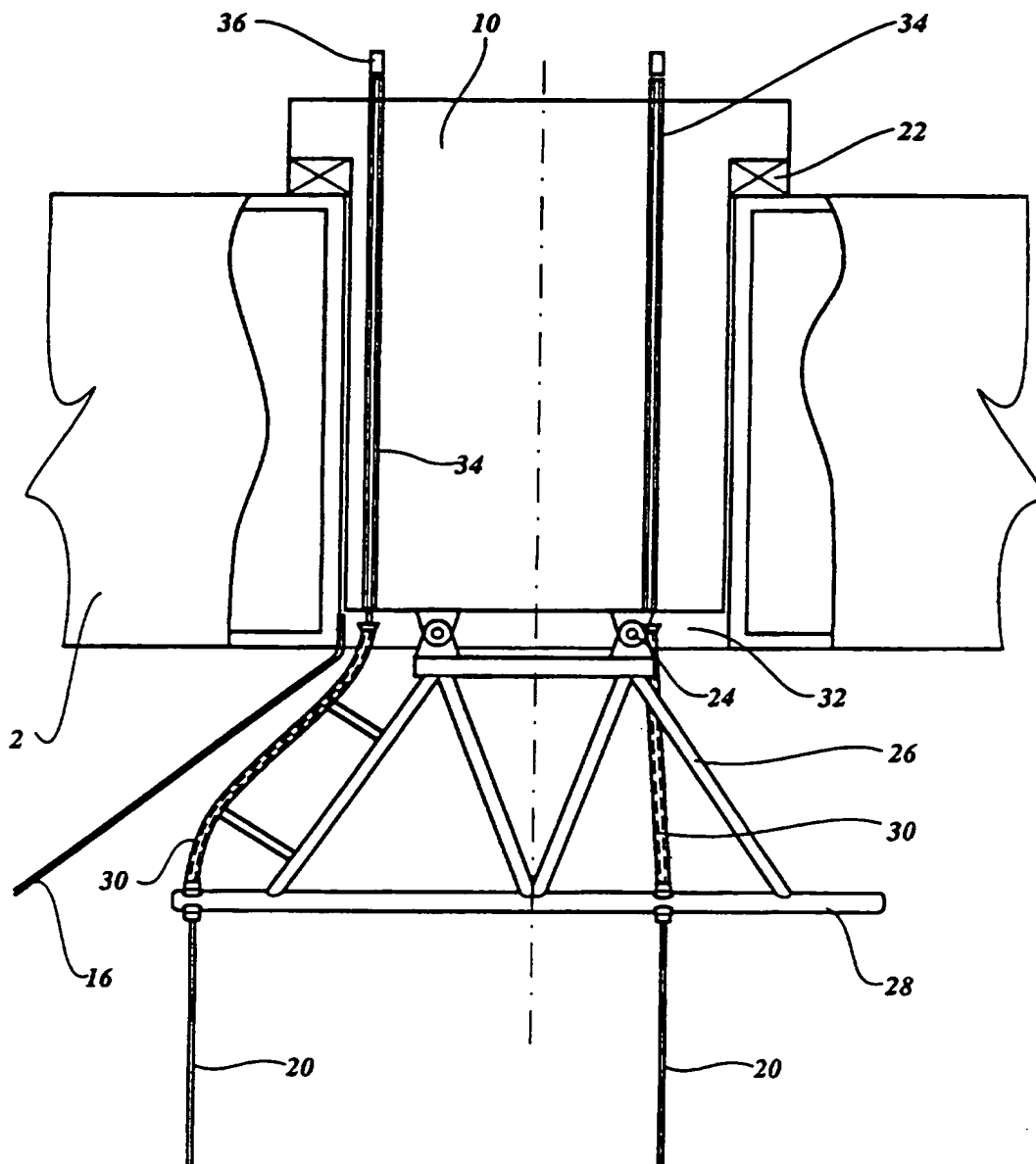


Fig. 1

**Fig. 2**

SINGLE POINT MOORING SYSTEM

The invention relates to a single point mooring system, comprising a central part to be anchored to the seabed, enclosing at least one conduit and having at the
5 bottom end connecting points for risers.

Increasingly existing tankers are being employed as Floating Production and Offshore Storage (FPSO) systems. Such tankers are to be connected by means of flexible risers to subsea oil production wellheads and to receive
10 the well fluids and to separate this fluid into oil, water and gas. The oil is subsequently stored in the tanker's cargo tanks awaiting trans shipment to shore once the tanker itself or by a second tanker to which the cargo is transferred at the oil production site.

15 In most cases the production tankers are being moored by a Single Point Mooring (SPM) System of the kind as described above. Such system is well known in the industry and e.g. discussed in US Patent 4 254 523.

Due to the need to increase the efficiency of such
20 systems, there is an increasing requirement to connect as many subsea wellheads as possible to the tanker.

Obviously the flexible risers, which provide the flow paths between the wellheads and the tanker deck (on which the oil water and gas separation plant is placed) have to
25 be routed through the Single Point Mooring System, particularly through the area where the actual rotating weathervaning interfaces of such Single Point Mooring System are provided.

It is equally obvious that, if one increases the
30 number of flexible rises, this also requires a larger rotating interface diameter.

As there is a need to provide a certain minimum spacing between adjacent risers for reasons of access and to prevent risers contacting each other in bad weather, the
35 need to resort to large rotating interface diameters when employing say 20 nor 30 risers becomes such that large costs are incurred in the fabrication and design of the Single Point Mooring System, particularly the rotating

interface i.e. the bearing system becomes a difficult and costly component.

These costs are mainly due to the overall size of the components and the need to machine these to strict 5 tolerances. In addition to this the tanker structure to support these components becomes large and in some ships it even becomes impractical to incorporate such large diameter turrets.

Consequently there is a need to minimize the rotating 10 interface diameter while still allowing a large space at the underside of the turret to pull in all risers at their preferred spacing. Also the hook-up and inspection of the upper riser termination flange without resorting to divers is preferred as it enhances safety and reduces operational 15 costs.

It is the object of the invention to achieve this with a simple structure, and according to the invention this is obtained in that:

- the connecting points are arranged at a distance from 20 the central part in the vicinity of the outer circumference of a structure with enlarged diameter, connected to said central part,
- each connecting point continues into a short upgoing conduit which converges towards the central part,
- 25 - the central part is provided with a number of vertical conduits, each ending at its lower end in the vicinity of the upper end of an upgoing conduit,
- each upgoing conduit and vertical conduit being 30 dimensioned so as to accommodate a riser, introduced therein via the connecting point and extending to the upper opening of the vertical conduit.

In a preferred embodiment the upgoing conduits are arranged in a detachable spacer frame, to be attached to the underside of the central part.

35 Preferably each vertical conduit is provided at its upper end with a riser hang-off coupling.

The invention will be elucidated on the hand of the accompanying drawings. Herein shows:

Figure 1 a general view of a tanker moored to a mooring system according to the invention.

Figure 2 a schematic cross-section through the structure according to the invention.

5 In figure 1 reference numeral 2 denotes a large tanker, used as a floating production and offshore storage system floating on the surface 4 of a body of water 6. The mooring system is denoted generally with reference numeral 8; it comprises a central part 10, connected to a bottom
10 structure 12 with a diameter which is considerable greater than the diameter of the central part 10. The mooring system is anchored to the seabed 14 by means of anchor chains 16. The interface between the conduits in this central part and the storage and production facilities on
15 the tanker are not shown.

The tanker 2 is used to store and process the products which are delivered by the wellheads 18 via flexible risers 20. These risers are connected to the bottom structure 12 of the mooring system 8.

20 As explained herein before for economical reasons as many risers as possible are to be connected to the mooring system, yet they must have sufficient spacing. In the known mooring system this results into a central part 10 with a very large diameter, which is both uneconomical and costly,
25 making it necessary to use interfaces with a large diameter. The unique structure proposed by the invention makes it possible to use a central part 10 with relatively small diameter, yet to accommodate a great number of risers at sufficient mutual distances. The whole structure is very
30 simple.

The central part or turret 10 is secured to the vessel 2 by means of a bearing system 22. At its bottom this central part is connected by means of releasable connections 24 to a frame 26 which supports at its lower
35 side a ring 28. The frame 28 supports a number of upgoing conduits 30, extending upwardly from the ring 28, converging towards each other at their upper ends 32 and ending below the central part 10. This central part accommodates a number of vertical conduits 34, of which the

respective lower ends lie above the respective upper ends of the conduits 30.

Each riser is guided, using a hook-up wire (not shown) through a respective one of the upgoing conduits 34 and 5 vertical conduits 34 and is then attached to the upper end of its vertical conduit by a locking arrangement 36. This can be the well-known, so-called riser "hang-off coupling".

The frame 26 is detachable at 24 and can be installed upon completion of the ship and turret; it can be removed 10 in sheltered water, for instance prior to docking.

As the drawings show a relatively large number of risers can be accommodated with a turret of relatively small cross-section.

CLAIMS:

1. Single point mooring system, comprising a central part to be anchored to the seabed, enclosing at least one conduit and having at the bottom end connecting points for
5 risers, characterised in that:
 - the connecting points are arranged at a distance from the central part in the vicinity of the outer circumference of a structure with enlarged diameter, connected to said central part,
 - 10 - each connecting point continues into a short upgoing conduit which converges towards the central part,
 - the central part is provided with a number of vertical conduits, each ending at its lower end in the vicinity of the upper end of an upgoing conduit,
 - 15 - each upgoing conduit and vertical conduit being dimensioned so as to accommodate a riser, introduced therein via the connecting point and extending to the upper opening of the vertical conduit.
2. Mooring system according to claim 1, characterised in
20 that the upgoing conduits are arranged in a detachable spacer frame, to be attached to the underside of the central part.
3. Mooring system according to claims 1-2, characterised in that each vertical conduit is provided at its upper end
25 with a riser hang-off coupling.
4. A mooring system substantially as hereinbefore described with reference to the accompanying drawings.

6

Patents Act 1977
Examiner's report to the Comptroller under Section 17
(The Search report)

Application number
GB 9502296.8

Relevant Technical Fields

- (i) UK Cl (Ed.N) B7V (VFA, VFB); B8E (E10)
(ii) Int Cl (Ed.6) B63B 21/50, 22/02

Search Examiner
A HABBIJAM

Date of completion of Search
16 MAY 1995

Databases (see below)

- (i) UK Patent Office collections of GB, EP, WO and US patent specifications.

Documents considered relevant following a search in respect of Claims :-
1-4

- (ii) ONLINE: WPI

Categories of documents

- | | |
|--|---|
| <p>X: Document indicating lack of novelty or of inventive step.</p> <p>Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.</p> <p>A: Document indicating technological background and/or state of the art.</p> | <p>P: Document published on or after the declared priority date but before the filing date of the present application.</p> <p>E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.</p> <p>&: Member of the same patent family; corresponding document.</p> |
|--|---|

Category	Identity of document and relevant passages	Relevant to claim(s)
A	EP 0259072 A1 (FLOATING TECHNOLOGY CO LTD)	1

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

☐ BLACK BORDERS

☐ IMAGE CUT OFF AT TOP, BOTTOM OR SIDES

☒ FADED TEXT OR DRAWING

☒ BLURRED OR ILLEGIBLE TEXT OR DRAWING

☐ SKEWED/SLANTED IMAGES

☐ COLOR OR BLACK AND WHITE PHOTOGRAPHS

☐ GRAY SCALE DOCUMENTS

☐ LINES OR MARKS ON ORIGINAL DOCUMENT

☐ REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY

☐ OTHER: _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.